DOCUMENT RESUME

ED 173 667 CE 022 532

TITLE	Health Occupations Module. The Skeletal System--I.
INSTITUTION	Temple Univ., Philadelphia, Pa. Div. of Vocational Education.
SPONS AGENCY	Pennsylvania State Dept. of Education, Harrisburg. Bureau of Vocational and Technical Education.
PUB DATE	Jan 78
NOTE	22p.; For related documents see CE 022 529-535 and CE 022 538
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Anatomy; Evaluation Methods; *Health Occupations Education; Individualized Instruction; Instructional Materials; Learning Modules; Postsecondary Education; Secondary Education
IDENTIFIERS	Pennsylvania; *Skeletal System

ABSTRACT

This module on the skeletal system is one of eight modules designed for individualized instruction in health occupations education programs at both the secondary and postsecondary levels. This module contains an introduction to the module topic, three objectives (e.g., define the skeletal system and list its functions), and three learning experiences. Each learning experience contains a learning activity (reading an information sheet contained in the module), a student self-check, and a model answer key. Topics covered in the learning experiences are functions of the skeletal system, bone composition and growth, and bone types and structures. Concluding the module is a student self-assessment form (four essay questions) and a student performance assessment form for use by the instructor. (JH)

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HEALTH OCCUPATIONS

MODULE

THE SKELETAL SYSTEM - I

DEPARTMENT OF VOCATIONAL EDUCATION

Temple University

of the Commonwealth System of Higher Education

Philadelphia, Pennsylvania

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
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January, 1978

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HEALTH OCCUPATIONS

MODULE

For the teacher...

ABOUT THE MODULE

DEPARTMENT OF VOCATIONAL EDUCATION

Temple University
of the Commonwealth System of Higher Education

Philadelphia, Pennsylvania

January, 1977

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For the teacher...

ABOUT THE MODULE

ORGANIZATION

Each module is designed to help the student to gain competence in an area considered important in health occupations.

Each module contains an introduction and a series of learning experiences. Overviews, which precede each learning experience except the final one, provide at a glance brief descriptions of what each learning experience entails.

Two types of objectives form the basis of the learning experiences: a terminal objective and enabling objectives. The enabling objectives are designed to help the student achieve the terminal objective. Each learning experience has activities designed to facilitate accomplishing the objective, and by use of the feedback devices provided, the student should be able to determine if he/she has reached each objective.

The first learning experience is designed to provide the needed background information. The remaining learning experiences are designed to provide the opportunity to apply that information in a practice situation. The final learning experience always requires the demonstration of the skill in an actual school situation.

PROCEDURE

1) Briefly discuss the purpose of the module.

2) Direct the students to review the introduction, the objectives and overviews preceding each learning experience, including the final learning experience.

3) The student needs to complete only those modules and/or learning experiences covering skills he/she does not already possess.

4) Answer the questions related to the module.

5) If the student decides that he/she is already competent in the specified area, provide him/her with an opportunity to "test out." Administer the "Final Learning Experience."

6) Instruct students who do not have the competencies indicated, to complete the module.

7) In cooperation with the student, determine a schedule for completing the module.

8) Instruct the student to make the necessary arrangements with you, the resource person, when he/she is ready to take the final learning experience.

9) If the student is unsuccessful in completing the final experience, instruct him/her to meet with you, the resource person, in order to provide for recycling through the module, or for completing some other activity suggested by the student or resource person and commonly agreed upon.

TERMINOLOGY

Actual School Situation -- refers to a situation in which one is actually a student in a real school.

Occupational Specialty Area -- refers to the student's major area of emphasis within the health occupations program.

Peers -- refers to fellow students who are used to:
1) role-play students, etc.,
2) critique the student's performance, and
3) participate in discussions.

Unless otherwise specified, these peers should be persons within the student's own occupational specialty.

Resource Person, Instructor -- refers to the person in charge of the student's educational program, i.e., the teacher who is guiding the student in taking the module.

You, Student -- refers to the person who is taking the module.

HEALTH OCCUPATIONS MODULE

designed for the purpose
of individualizing instruction
in the health related occupations
program.

Prepared by...

Temple University of the Commonwealth System of Higher Education
Philadelphia, Pennsylvania

DEPARTMENT OF VOCATIONAL EDUCATION

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Acknowledgement...

Special recognition is extended to A. Louise Harding, Senior Program Specialist, Health Occupations Education, Bureau of Vocational Education, for her direction, support and encouragement of this project.

PREREQUISITE

There are no prerequisites to this module.

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Introduction

Increasingly complex and specialized health occupations demand well prepared health care workers. The structure and function of the human body are important areas of study common to all health careers. Job skills, occupational advancement and advanced education are based on a solid foundation of information about anatomy and physiology and related sciences. In addition, the common language of medical terminology binds all health care workers together.

The information which follows is directed toward beginning health care workers and their need for a concise, readable and understandable introduction to the scientific basis of their career. It is written for all the health occupations and does not treat health and disease from the perspective of any specific health career.

This module emphasizes normal anatomy and physiology of the skeletal system. Because that system is relatively complicated, you should not feel discouraged if you do not learn all the names and functions of the various parts immediately. This module will always be available for study and rereading. Consult it freely. Someday you will no longer need refer to it, for the skeletal system will have become part of your intrinsic knowledge.

Resources

This module is intended as a guide for your study of the skeletal system. You are free to explore other resources on your own initiative.

Objectives

Terminal Objective

Demonstrate competence in the knowledge of the skeletal system.

Enabling Objectives

1. Define the skeletal system and list its functions.

2. Describe bone composition, formation and growth.

3. List the types of bones, describe their structural parts, and identify examples of each.

Procedure

After reading the preceding "Introduction" and "Objectives," determine how much of this module you will need to complete in order to accomplish the stated objectives, based upon your present competencies.

If you already have the necessary background knowledge required for proficiency in knowledge of the skeletal system, you may not need to complete all the learning experiences.

You may wish to skim the "Overviews" for the Learning Experiences and complete the "Self Check" questions associated with each of the experiences. In addition, you may wish to compare your answers with the "Self Check" answers which are provided with each Learning Experience.

Terminology

Use this page for listing and defining terminology of the skeletal system.

Learning Experience I

Overview

Enabling Objective	Define the skeletal system and list its functions.
Activity 1	Read the "Information Sheet Defining and Listing the Functions of the Skeletal System."
Activity 2	Complete the "Self Check."
Feedback	Compare your completed "Self Check" with the "Model Answers."

(Activity 1)

Information Sheet Defining and Listing the Functions of the Skeletal System

The skeletal system is one of the major subdivisions of the locomotive system. It includes all the bones in the body. Osteology is the scientific name given to the study of the function and structure of bones. There are 206 bones in the average human body. The bones of the skeleton are commonly grouped into two divisions: the axial skeleton and the appendicular skeleton. The axial division consists of the bones of the skull, the vertebrae, the hyoid bone, the sternum and the ribs. These form the head and torso, or axis of the body. The appendicular division, as its name suggests, includes the bones of the upper and lower extremeties, that is, the arms and legs and the bones which connect them to the axial portion of the skeleton.

The main functions of the skeletal system are to:

1. give the body shape and support.
2. protect the delicate organs underneath the bones, e.g., the chest cavity which is protected by the sternum and rib cage.
3. provide a place for the attachment of muscles.
4. produce blood cells, e.g., red blood corpuscles, platelets and some white blood cells.
5. serve as a storehouse for calcium, which is continually being moved in and out of bones. A small amount of calcium is carried in the blood. When the blood calcium level decreases below normal, stored calcium is released from bones to replenish the supply in the blood.

An orthopedic physician specializes in the treatment of bone disorders.

(Activity 2)

"SELF CHECK"

1. _____ is the study of the function and structure of bones.

2. Bones which include the skull and vertebrae are generally classified as the _____ skeleton.

3. The _____ division of the skeletal system includes the bones of the upper and lower extremeties.

4. The main functions of the skeletal system are to:

   1) _____
   2) _____
   3) _____
   4) _____
   5) _____

5. An _____ physician specializes in the treatment of bone disorders.

Feedback:

Model Answers

1. Osteology is the study of the function and structure of bones.

2. Bones which include the skull and vertebrae are generally classified as the axial skeleton.

3. The appendicular division of the skeletal system includes the bones of the upper and lower extremeties.

4. The main functions of the skeletal system are to:

   1) give the body shape and support
   2) protect delicate organs
   3) provide a place for the attachment of muscles
   4) produce blood cells
   5) serve as a storehouse for calcium

5. An orthopedic physician specializes in the treatment of bone disorders.

Learning Experience II

Overview

Enabling Objective	Describe bone composition, formation and growth.
Activity 1	Read the "Information Sheet on Bone Composition, Formation and Growth."
Activity 2	Complete the "Self Check."
Feedback	Compare your completed "Self Check" with the "Model Answers."

(Activity 1)

Information Sheet on Bone Composition, Formation and Growth

All bones have roughly the same basic structure, even though they vary in size, shape and exact consistency, and some are more compact than others. Bone is living, growing tissue which requires nourishment the same as other tissues. To know how bones are nourished and grow requires some knowledge of their composition.

In the early stages of the development of the human embryo, the skeleton is composed almost entirely of cartilage, with a few membranes taking the place of bone in some regions. After about the second or third month of development, however, certain cartilage cells disappear and are replaced by bone cells. These cells deposit an inorganic salt, calcium phosphate, in the spaces between them.

Calcium phosphate makes the bones hard and rigid. Hard bone is yellowish-white in color and looks somewhat like ivory. This hardening process is called ossification and occurs mainly throughout childhood, but continues at a reduced rate throughout a person's entire lifetime.

Although bones need to be strong, they must be light enough in weight to permit ease of bodily movement. Otherwise, movement would be clumsy and overtiring, and the individual would be less able to adapt to the stresses and dangers of the environment.

In addition to the calcium phosphate inorganic salt, bones are composed of water and organic material, viz., bone cells, blood vessels and cartilaginous substance (collagen). The amount of inorganic salt in bones increases with age. A child's bones are less brittle and much more flexible than those of an adult. They bend more easily and are less likely to be broken than the more rigid bones of an adult. When a child's bone is fractured, however, it breaks like a "green stick."

Calcium and phosphorus are the two minerals which are essential in the diet for good bone formation. These compounds enter the body in food and are carried in the bloodstream to the bone tissue. Vitamin D is necessary for the utilization of calcium and phosphorus. Fluorides are also important in increasing the strength of bones. Thus, the diet is an important factor in governing the formation and growth of bones.

Bones grow along lines of stress. In other words, they become heaviest and strongest where the strain is greatest. This fact is important in dealing with bone fractures. If a broken bone is protected by a cast and is unused during that period of repair, the fact that it is under no stress delays healing.

For example, if a leg is broken, the patient is provided with a walking cast, which puts the broken bone under limited stress during the healing period and speeds up the repair process. On the other hand, if a

patient is immobilized, as occurs in patients restricted to prolonged bed rest, or as occurs in paralyzed patients, there is interference with proper utilization of calcium by the bones. Thus, the body loses calcium through increased excretion in the urine, which may result in kidney stones.

(Activity 2)

"SELF CHECK"

1. Early in embryonic development, a pattern for the skeleton is formed, consisting of tissue called
   _____ a) cartilage
   _____ b) osseous
   _____ c) mesenchyme
   _____ d) cancellous

2. The process by which cartilage is replaced by bone is called _____.

3. Calcium requires the nutrient _____ in order to be utilized or absorbed by the digestive system.

4. Bones are composed of
   1)_____
   2)_____
   3)_____

5. The two minerals which are essential in the diet for good bone formation are
   1)_____
   2)_____

6. _____ are important in increasing the strength of bones.

7. _____ interferes with proper utilization of calcium by the bones.

8. The _____ is the most important factor in governing the formation of bones.

9. Bone is living, growing tissue eeding nourishment the same as other tissues.
   _____ true
   _____ true
   _____ false

10. Bones grow along lines of stress.
    _____ true
    _____ false

Feedback:

Model Answers

1. Early in embryonic development, a pattern for the skeleton is formed, consisting of tissue called (a) cartilage.

2. The process by which cartilage is replaced by bone is called ossification.

3. Calcium requires the nutrient vitamin D in order to be utilized or absorbed by the digestive system.

4. Bones are composed of
   1) inorganic salts
   2) water
   3) organic salts

5. The two minerals which are essential in the diet for good bone formation are
   1) calcium
   2) phosphorus

6. Fluorides are important in increasing the strength of bones.

7. Immobilization interferes with proper utilization of calcium by the bones.

8. The diet is the most important factor in governing the formation of bones.

9. true

10. true

Learning Experience III

Overview

Enabling Objective	List the types of bones, describe the bone structural parts, and give examples of each.
Activity 1	Read the "Information Sheet on Bone Types and Structures."
Activity 2	Complete the "Self Check."
Feedback	Compare your completed "Self Check" with the "Model Answers."

(Activity 1)

Information Sheet on Bone Types and Structures

The 206 bones of the skeletal system are classified into five types according to shape:

1. Long bones -- e.g., humerus, radius, ulna, femur, tibia and fibula.
2. Short bones -- e.g., wrist and ankle bones.
3. Flat bones -- e.g., ribs, sternum, scapula and some skull bones.
4. Irregular bones -- e.g., vertebrae and jaw bones.
5. Sesamoid bones (small and rounded) -- e.g., the patella (largest of the sesamoids). (Commonly found in the hand or foot, the function of the sesamoid bones is to prevent friction.)

Two types of bone, compact or hard bone and cancellous or spongy bone, work together to give strength to bones. The diaphysis is the bone shaft, which is the long, hard portion between the two ends. It is composed mainly of hard bone (tightly packed bone tissue) to give it strength and the ability to take strain. Weight-bearing helps to keep the long bones in good growth condition. The diaphysis has a core filled with a yellow substance called marrow. The bone marrow cavity in the center of the long bone is lined with cancellous (spongy) bone.

The epiphyses are the two ends of long bones. They are composed of hard bone on the outside and spongy bone on the inside.

Bone linings: The periosteum, which covers the shaft of the bone but not the ends, is a tough, fibrous membrane containing blood vessels and bone-forming cells. It has several functions:

a) makes, repairs and increases the circumference of bones.
b) serves in bone nutrition.
c) serves as a means of attaching tendons and ligaments to bones.

2. The endosteum, a membrane which lines the marrow cavity, contains bone-destroying cells. These cells allow for the increase of the bone marrow cavity which accompanies the growth in circumference of the bone.
3. The articular cartilage is the thin layer of cartilage covering the ends of long bones. The function of the cartilage is to help prevent friction between the ends of bones in a joint.
4. The epiphyseal cartilage is a layer of cartilage between the epiphysis and the diaphysis, which is present until long bone structure is complete. The portion called "line of epiphyseal fusion" is known as the growth plate. It is here that a bone lengthens.

Bones grow and they change as they grow. On the average a female needs about 20 years to attain full bone growth, while it takes the male some three years longer. All bones complete their ossification by about age twenty-five.

(Activity 2)

"SELF CHECK"

1. The normal human body contains a total of approximately _____ bones.

2. The shaft of a long bone is the
   _____a) periosteum
   _____b) diaphysis
   _____c) epiphysis
   _____d) perichondrium

3. An example of an irregular bone is the
   _____a) carpal
   _____b) vertebra
   _____c) femur
   _____d) scapula

4. The primary function of the marrow is
   _____a) to produce red blood cells
   _____b) to aid in protection of soft tissue
   _____c) to store calcium and phosphorus
   _____d) to produce new osteocytes

5. Growth in the length of long bones is accomplished by
   _____a) bone production in the diaphysis
   _____b) bone production at the epiphysis
   _____c) ossification in the narrow cavity
   _____d) ossification of the perichondrium

6. The connective tissue surrounding the shaft which produces bone cells is the _____.

7. List five types of bones found in the human body.
   1) _____
   2) _____
   3) _____
   4) _____
   5) _____

8. Another name for spongy bone is _____.

9. List three functions of the periosteum.
   1) _____
   2) _____
   3) _____

10. The _____ cartilage covers the ends of long bones and prevents friction between the ends of bones in a joint.

Feedback:

Model Answers

1. The normal human body contains a total of approximately 206 bones.

2. The shaft of a long bone is the (b) diaphysis.

3. An example of an irregular bone is the (b) vertebra.

4. The primary function of the marrow is (a) to produce red blood cells.

5. Growth in the length of long bones is accomplished by (b) bone production at the epiphysis.

6. The connective tissue surrounding the shaft which produces bone cells is the periosteum.

7. Five types of bones found in the human body:
   1) Long
   2) Short
   3) Flat
   4) Irregular
   5) Sesamoid

8. Another name for spongy bone is cancellous bone.

9. Three functions of the periosteum:
   1) makes, repairs and increases the circumference of bones.
   2) serves in bone nutrition.
   3) serves as a means of attaching tendons and ligaments to bones.

10. The articular cartilage covers the ends of long bones and prevents friction between the ends of bones in a joint.

FINAL EXPERIENCE

Student Self-Assessment Form

1. Write a brief essay defining and listing the functions of the skeletal system.

2. Discuss bone composition, formation and growth.

3. Discuss some bone types and structures.

4. You have no doubt compared the information in your three brief essays above with the information sheets contained in this module. Based on this comparison, how well do you know the skeletal system? What resources other than this module have you used in your study of this topic? Discuss the skeletal system freely with your fellow students and your resource person.

STUDENT PERFORMANCE ASSESSMENT FORM

DEFINITION AND FUNCTIONS OF THE SKELETAL SYSTEM

	LEVEL OF PERFORMANCE	
	Satisfactory	Unsatisfactory
Osteology Definition.....		
Bones of the Skeleton Number..... Two main divisions..... Main divisions of the axial system (5)..... Appendicular system Definition.....		
Functions of the Skeletal System (5) Name.....		
Orthopedic physician Definition of specialty.....		
BONE COMPOSITION, FORMATION AND GROWTH		
Name the tissue which forms a pattern for the skeleton early in embryonic development.....		
Name the process by which cartilage is replaced by bone.....		
Name the nutrient calcium requires in order to be utilized or absorbed by the digestive system..		
Name the 3 substances of which bones are composed.....		
Name 2 minerals essential in the diet for good bone formation.....		
Name the function of fluorides.....		

Instructor's Signature _____

Instructor's Comments: